

Field-Portable Digital Radiography and Computed Tomography (DRCT) of Munitions

The INEEL has developed and implemented field-portable, high-resolution Digital Radiography and Computed Tomography (DRCT) systems for nonintrusive inspection of munitions and containers of munitions. These x-ray systems are used to determine type, number, and configuration of munitions in containers, status of the fuzing and firing train, physical integrity of individual munitions and their containers, and liquid levels when present. This information is used to make decisions on safe handling and storage of munitions and to aid in content identification.

These systems incorporate vertically scanning x-ray sources, linear detector arrays, and object-rotational staging. For field scanning of single munitions within containers (Figure 1), a transport dolly serves as the mounting stand for the modular imaging assembly.

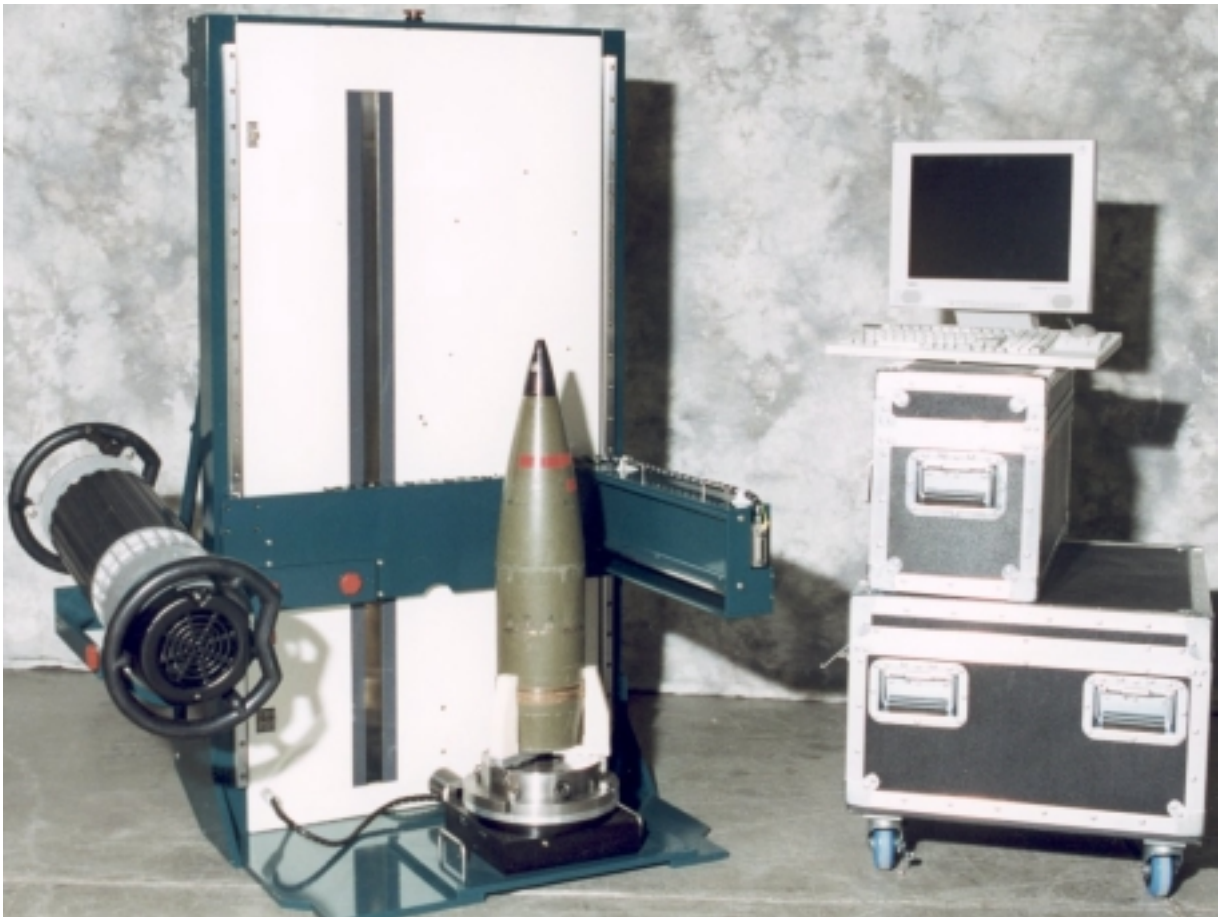


Figure 1. The field-portable x-ray Digital Radiography and Computed Tomography (DRCT) scanning system. Radiographs are obtained by simultaneous vertical motion of source and detector. Tomographic data is obtained by simultaneous vertical translation of source and detector with object rotation. Objects up to 40" in height and 12" diameter may be imaged. The x-ray tube head, detector, and rotational stage are removed and placed in cases for transport. The system has been transported in station wagons, minivans, trailers and motor homes.



Figure 2. Transportable x-ray scanning system for larger objects. This system can acquire complete images of objects as large as an 85-gallon drum. It is transported to a site in a trailer, rolled into place, and set onto leveling jacks to provide mobility within a facility.

For scanning of larger objects, larger scanning systems have been developed. The scanning system shown in figure 2 can fully image an 85-gallon drum. It resides on 8" wheels and may be easily moved within a facility or placed in a trailer for transportation to remote locations. This system uses a 450kV x-ray generation system and 1024-element high-resolution linear detector array.

All system functions on our scanners can be controlled remotely up to 300 feet. On the portable singles scanner, a conventional digital x-ray of a munition or over-pack, up to 12 inches in diameter and 40 inches long, can be produced in less than two minutes. A two-dimensional tomographic slice at any height on the munition can be produced in less than one minute, while full 3-D images may be generated in about 10 minutes. Likewise, scanning an 85-gallon drum on the larger scanner can be achieved in five minutes or less. The INEEL DRCT image processing and display software allows the operator to review, process, interpret, and distribute images immediately following acquisition.

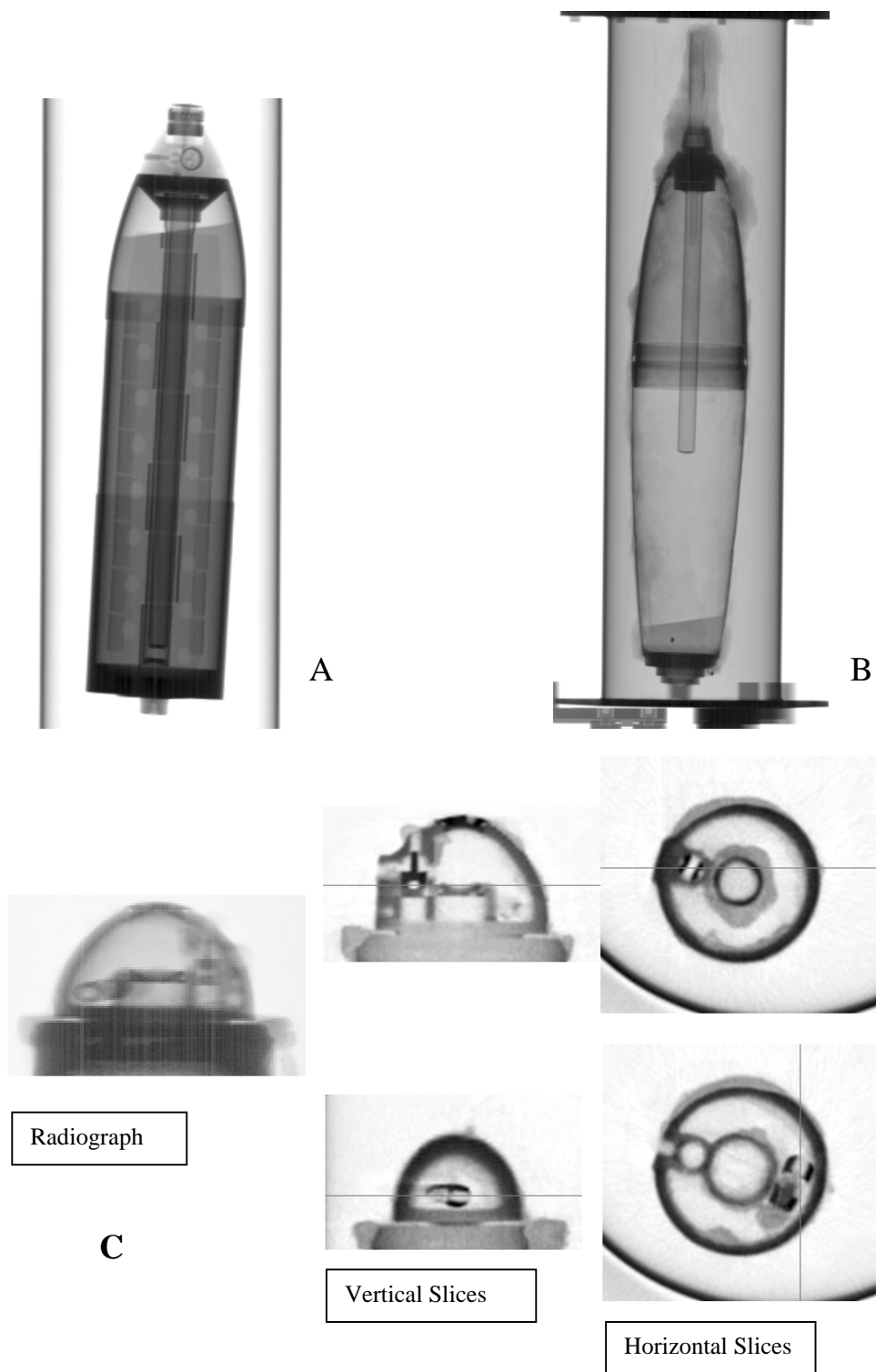
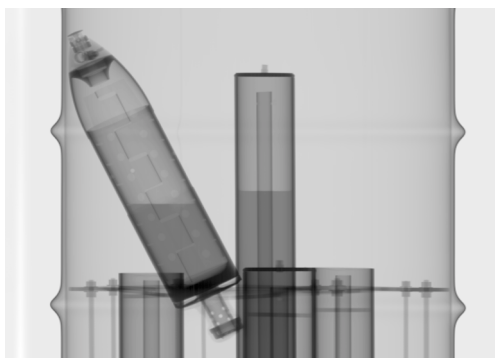


Figure 3. Images acquired with the field-portable x-ray system. Figure 3A is a pristine 4.2" mortar, nearly filled with water. Figure 3B is a WWI-era projectile. Figure 3C shows a combination of a radiograph and tomographic slices of a fuze retrieved after burial for more than 60 years. The left image is a radiograph while the four images on the right represent different vertical and horizontal slices through the fuze. The line running through each tomographic slice is an indicator of the location within the fuze of the neighbor image.



A



B

Figure 4. Images of a surrogate drum acquired with the mobile drum scanner. Image A is a radiograph of a drum over the middle vertical region. Image B is a tomographic slice at a level where only the two upper cylindrical objects are positioned.

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